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ABSTRACT

This study measured the influence of air conditioning, carpeting, fluorescent lighting, and interior pastel coloring on the academic achievement of eighth grade Georgia pupils in 1975-76 when the variance due to socioeconomic status was statistically controlled. Analysis of covariance was used to compare the achievement scores of students on the Iowa Test of Basic Skills. Pupil achievement in air conditioned school buildings was consistently higher than pupil achievement in non-air conditioned school buildings. This consistent pattern did not exist between carpeted school buildings and noncarpeted school buildings, between school buildings with fluorescent lighting and school buildings without fluorescent lighting, and between school buildings with interior pastel coloring and school buildings without interior pastel coloring. (Author/MLF)

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PHYSICAL ENVIRONMENT AND MIDDLE GRADE ACHIEVEMENT

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PHYSICAL ENVIRONMENT AND MIDDLE GRADE ACHIEVEMENT

INTRODUCTION

Since three decades ago, as a result of educational research and technological development, air-conditioning[1], carpeting[2], fluorescent lighting[3] and interior pastel coloring[4] have been used in many school buildings to improve the thermal, acoustical, visual and aesthetic environments of the educational setting. Consequently, one would expect to see better pupil achievement in improved physical environment of the schools.

Research findings indicated that physical environment had a significant impact on pupil achievement. (Luckiesh & Moss, 1940; Rice, 1953; Burnette, 1962; Conrad & Gibbons, 1963; Stuart & Curtis, 1964; Killough, 1971; Jefferys, 1971; Sudbury Study, 1972; Ertel, 1973; McGuffey & Brown, 1978; Plumley, 1978; Chan, 1979) Most of the studies involved pupils in elementary and secondary levels. Studies on the relationship of physical environment and pupil achievement in middle level are scarce. It is the purpose of this study to examine the achievement of middle graders under different physical environments.

Specifically, this study was intended to seek answers to the following questions:

1. How does the academic achievement of pupils in air-conditioned school buildings compare with the academic achievement of pupils in non-air-conditioned school buildings?

2. How does the academic achievement of pupils in carpeted school buildings compare with the academic achievement of pupils in non-carpeted school buildings?

3. How does the academic achievement of pupils in school buildings with fluorescent lighting compare with the academic achievement of pupils in school buildings without fluorescent lighting?

4. How does the academic achievement of pupils in school buildings with interior pastel coloring compare with the academic achievement of pupils in school buildings without interior pastel coloring?

REVIEW OF SELECTED RELATED LITERATURE

This study involves four environmental characteristics: air-conditioning, carpeting, fluorescent lighting and interior coloring.

Peccolo's study (1962) showed great improvement on the part of pupils housed in better thermal environment. McCardle's follow-up study (1966) also indicated that pupils in improved thermal environment made significantly fewer errors and required less time to complete the tasks than did pupils in the regular classroom. Stuart and Curtis's experiment (1964) showed that the gain of pupil achievement in climate-controlled schools was superior to that in non-climate-controlled schools. In addition, the impact of thermal environment on pupil achievement is also supported by studies of Manning and Olsen (1964), Mayo (1955) and McDonald (1960).

Conrad and Gibbons (1963) found that the achievement of pupils in carpeted schools was significantly higher than the achievement of pupils

in non-carpeted schools in elementary level; however, no significant difference was found in the middle level. Cunliff's survey (1967) on teacher reaction towards carpeting indicated that a carpeted room was more conducive to learning.

Tinker (1939) indicated that there was an effect of changes in illumination intensity upon speed of perception and upon fatigue in reading. In a series of tests on fifth and sixth graders performed by Luckiesh and Moss (1940) there was a significant increase in pupil testing scores in a well lighted classroom over a poorly lighted classroom. Studies by Chorlton and Davidson (1959), Blackwell (1963) and Sampson (1970) also support the idea that proper school lighting produces a visual environment in which a person may see efficiently and without distraction.

The influence of interior coloring on academic achievement was investigated by a number of researchers. Rice (1953) studied the achievement of pupils in three schools painted with different shades of color. He concluded that the school painted with light colors positively influenced pupil achievement. In a similar study, Ketcham (1964) concluded that the school painted with a special combination of colors showed the greatest improvement in each of the academic areas studied. Ertal and his fellow researchers (Time, September, 1973) found that the proper combination of colors could raise the average I.Q. of children and improve their social reactions.

Facts documented by these researches, though not conclusive, appear to support the following postulates:

1. Human activities are under the influence of total physical environment.

2. Air-conditioning, an effective means of control over thermal environment, has a significant influence on pupil performance.

3. Carpeting, an essential means to achieve acoustical effect, seems to help improve pupil achievement.

4. Better quality lighting, such as fluorescent lighting, improves pupil visual performance.

5. Interior pastel coloring, especially a proper combination of pastel colors, has a positive influence on pupil achievement.

METHOD

Subjects

The subjects of this study were 191 public standard schools containing the eighth grade in 1975-76 in the State of Georgia.

Sources of Data

The data for this study were obtained from the results of the eighth grade Georgia pupils in the Iowa Test of Basic Skills in 1975-76 and from demographic information obtained from a questionnaire completed by the principals of Georgia standard schools containing the eighth grade. The questionnaire asked about the pupils' immediate environment: whether the eighth grade instructional rooms were air-conditioned, whether they were carpeted, whether they were installed with fluorescent lighting and whether they were painted with pastel colors. Further question was asked about the percentage of paid pupil participation in school lunch program in the eighth grade.

Procedure

Schools in this study were classified into eight types: (1) air-conditioned schools, (2) non-air-conditioned schools, (3) carpeted schools, (4) non-carpeted schools, (5) schools with fluorescent lighting, (6) schools without fluorescent lighting, (7) schools with interior pastel coloring, and (8) schools without interior pastel coloring.

Analysis of covariance was used to compare the achievement scores of Type (1) schools and Type (2) schools, Type (3) schools and Type (4) schools, Type (5) schools and Type (6) schools, Type (7) schools and Type (8) schools. The percentage of paid pupil participation in school lunch program was used as covariate to control the variations in achievement due to the effect of socio-economic status.

With the use of standard schools in this study, variations in achievement due to the overall effect of such variables as teacher qualification, teacher-pupil ratio and per pupil expenditure were minimized by the requirements established in the "Standards for Public Schools in Georgia, 1975".

FINDINGS

When the effect of socio-economic status had been statistically controlled, the vocabulary scores of the Iowa Test of Basic Skills (ITBS) in air-conditioned schools was higher than the vocabulary scores of the ITBS in non-air-conditioned schools. The difference in achievement was indicated by an F-value of 7.123 which was significant at the .05 level. The achievement scores of air-conditioned schools and non-air-conditioned schools were also analysed in the composite section, the

reading section, the language section, the work-study section, and the mathematics section of the ITBS. No significant difference was found. However, statistics showed a consistent pattern of achievement in air-conditioned schools being higher than achievement in non-air-conditioned schools.

Statistics also showed no significant difference between the achievement scores in carpeted schools and the achievement scores in non-carpeted schools in the composite section, the vocabulary section, the reading section, the language section, the work-study section and the mathematics section of the ITBS.

The achievement scores in schools with fluorescent lighting were compared with the achievement scores in schools without fluorescent lighting in the composite section, the vocabulary section, the reading section, the language section, the work-study section and the mathematics section of the ITBS. Statistics indicated that the differences in achievement were too small to be significant.

No significant difference in achievement was detected in the composite section, the vocabulary section, the reading section, the language section, the work-study section and the mathematics section of the ITBS when the achievement scores of schools with interior pastel coloring were compared with achievement scores of schools without interior pastel coloring.

A summary of statistics is presented in the following table:

SUMMARY OF STATISTICS IN ANALYSIS OF COVARIANCE							
		Iowa Test of Basic Skills					
		Comp. Scores	Vocab. Scores	Read. Scores	Lang. Scores	Work. Scores	Math. Scores
Type 1 vs. Type 2	Grand Mean	930.04	922.70	931.30	916.20	936.40	935.98
	AAD (Type 1)	4.37	7.65	1.85	5.25	2.40	2.82
	AAD (Type 2)	-4.80	-8.41	-2.04	-5.78	-2.64	-3.10
	F-Value	2.84	*7.12	0.51	3.51	0.92	1.29
Type 3 vs. Type 4	Grand Mean	931.24	923.63	932.65	917.39	937.61	937.02
	AAD (Type 3)	-0.74	6.42	-3.45	-7.23	-0.31	3.44
	AAD (Type 4)	0.11	-0.93	0.50	1.05	0.05	-0.05
	F-Value	0.01	0.67	0.25	0.89	0.00	0.26
Type 5 vs. Type 6	Grand Mean	930.03	922.75	931.29	916.35	936.27	935.90
	AAD (Type 5)	0.72	2.24	0.60	-0.49	-0.26	1.01
	AAD (Type 6)	-2.70	-8.47	-2.28	1.84	0.97	-3.80
	F-Value	0.27	2.16	0.20	0.11	0.04	0.59
Type 7 vs. Type 8	Grand Mean	931.15	923.74	932.23	917.70	937.46	936.70
	AAD (Type 7)	-0.48	0.74	-1.40	-0.85	-0.53	-1.19
	AAD (Type 8)	0.98	-1.52	2.87	1.74	1.08	2.45
	F-Value	0.06	0.12	0.55	0.17	0.08	0.43

Type 1 -- Air-conditioned schools
Type 2 -- Non-air-conditioned schools
Type 3 -- Carpeted schools
Type 4 -- Non-carpeted schools
Type 5 -- Schools with fluorescent lighting
Type 6 -- Schools without fluorescent lighting
Type 7 -- Schools with interior pastel coloring
Type 8 -- Schools without interior pastel coloring

AAD -- Adjusted Average Deviation

* $p < .05$

CONCLUSIONS

This study has examined the achievement of middle grade pupils under different physical environments. Specifically, this study has determined the influence of air-conditioning, carpeting, fluorescent lighting and interior pastel coloring on the academic achievement of the eighth grade Georgia pupils in 1975-1976 when the variance due to socio-economic status has been statistically controlled.

Question 1

How does the academic achievement of pupils in air-conditioned school buildings compare with the academic achievement of pupils in non-air-conditioned school buildings?

Statistics showed that pupil vocabulary scores of ITBS were significantly higher in air-conditioned school buildings than in non-air-conditioned school buildings. In composite scores, reading scores, language scores, work-study scores and mathematics scores of ITBS, pupils in air-conditioned school buildings achieved consistently higher than pupils in non-air-conditioned school buildings, even though these score differences were not significant at the .05 level.

Question 2

How does the academic achievement of pupils in carpeted school buildings compare with the academic achievement of pupils in non-carpeted school buildings?

The academic achievement of pupils in carpeted schools was compared with the academic achievement of pupils in non-carpeted schools in the eighth grade. In composite scores, vocabulary scores, reading scores, language scores, work-study scores and mathematics scores of ITBS,

statistics did not show any significant difference at .05 level.

Question 3

How does the academic achievement of pupils in school buildings with fluorescent lighting compare with the academic achievement of pupils in school buildings without fluorescent lighting?

The academic achievement of eighth grade pupils in school buildings with fluorescent lighting was compared with the academic achievement of eighth grade pupils in school buildings without fluorescent lighting. In composite scores, vocabulary scores, reading scores, language scores, work-study scores and mathematics scores of ITBS, statistics did not show any significant difference at .05 level.

Question 4

How does the academic achievement of pupils in school buildings with interior pastel coloring compare with the academic achievement of pupils in school buildings without interior pastel coloring?

The academic achievement of eighth grade pupils in schools with pastel coloring was compared with academic achievement of eighth grade pupils in schools without pastel coloring. In composite scores, vocabulary scores, reading scores, language scores, work-study scores and mathematics scores of ITBS, statistics did not indicate any significant difference at .05 level.

In summary, this study did not show any significant evidence of negative impact of improved physical environment on pupil achievement. On the other hand, there was evidence to indicate a tendency of better pupil achievement in improved physical environment with different degrees of impact by type of environment. Therefore, the impact of

physical environment on middle grade achievement has been basically supported.

DISCUSSION

One of the important findings of this study was that pupil achievement in air-conditioned school buildings was consistently higher than pupil achievement in non-air-conditioned school buildings throughout all sections of the ITBS. This consistent pattern did not exist between carpeted school buildings and non-carpeted school buildings, between school buildings with fluorescent lighting and school buildings without fluorescent lighting, and between school buildings with interior pastel coloring and school buildings without interior pastel coloring. Since all these analyses were made on the same group of subjects, evidence seems to indicate that air-conditioning has a greater influence on pupil achievement than carpeting, fluorescent lighting and interior pastel coloring.

Additionally, statistics in this study showed that achievement difference between types of school buildings was significant in only one of the twenty-four analyses. The large number of non-significant cases at .05 level could be a result of the influence of complexity of characteristics that are unique of middle grade children. Since the results of three previous studies (Conrad & Gibbons, 1963; McGuffey & Brown, 1978; Brown, 1978) also showed more non-significant cases in middle level than any other levels observed, further research about physical environment in the middle level is needed.

NOTES

1. Air-conditioning has been proved to be a very effective means of thermal control. It has become part of the many essential facilities in a modern school building.
2. Carpeting in school building is no longer a luxury. Carpeting essentially helps to achieve a better acoustical effect in an indoor educational environment.
3. Fluorecent lighting is generally considered to be a better quality lighting as compared to incandescent lighting. Fluorescent lighting provides a better distribution of light in a learning environment.
4. Pastel color refers to lighter shades of blue, yellow, orange, red and green; excludes black, grey and dark shades of brown, green, blue and red.

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